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⑥ CONGRATS TEMPERATURE AND SALINITY
TO SOUND SPEED CONVERSION.

by

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⑨ USL Technical Memorandum No. 2070-412-69

⑪ 10 November 1969

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INTRODUCTION

CONGRATS (CONTINUOUS GRADIENT RAY TRACING SYSTEM) is an integrated collection of ray tracing programs designed to model acoustic propagation and reverberation, as described in references (a) and (b). Although sound speed data is often obtained from temperature and salinity readings at various depths, the fundamental CONGRATS programs, S0990 and S0991, formerly required a table of velocity versus depth as an input. Hence, it was sometimes necessary to convert the empirical data into a velocity-depth profile before using the CONGRATS series. CONGRATS has now been revised to convert a temperature and salinity profile to a velocity profile automatically. Velocity data, in the format described previously in reference (a), is still accepted by the programs. It is hoped, however, that the use of the new option will remove the burden of some preliminary hand computations from the user. This memorandum will contain a discussion of the method used in the conversion of temperature to velocity, a detailed description of the data necessary to implement the conversion, a sample run along with its output, and a listing of the revised Subroutine INPUT and the new Subroutine BT.

METHOD

Although Wilson's equation is most widely used in the calculation of sound speed in water, a simplified formula was programmed for the CONGRATS series. According to C. C. Leroy, this formula fits Wilson's data with a better accuracy than does Wilson's equation (over a domain restricted to areas of operational interest) and approaches Greenspan

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and Tschiegg's results for very low salinity water (see reference (c)). The formula is presented in Table 1.

The basic formula, $V = V_0 + V_a$, is sufficiently accurate (see reference (c)) under the following conditions: depth less than 7,000 meters, temperature less than 25° Centigrade, and salinity between 30 and 40 parts per thousand. The remaining three terms are added for increased accuracy if the above conditions are not met. If the temperature is greater than or equal to 25° centigrade, the correction term V_b is added; if the depth is greater than 7,000 meters, V_c is added; and if the salinity is less than 30 parts per thousand, V_d is added.

DATA DESCRIPTION

The input deck of CONGRATS Programs S0990 and S0991, as described in reference (a), consists of sets, each of which is an ordered collection of standard, eighty-column, punched cards. The conversion of temperature and salinity data to a velocity profile is implemented by substituting a temperature and salinity profile set for the velocity profile set. The rest of the input deck is unaffected by this change. The first card of the temperature and salinity profile set is divided into six fields of ten columns each, following the format convention set in reference (a). The first field contains the word "THERMAL," starting in column 1, and the second contains the word "PROFILE," starting in column 11. These two fields identify the temperature and salinity profile set. The third field contains either the word "CONTINUOUS," in which case the resultant velocity profile is fitted with continuous gradients, or the word "CONSTANT," in which case the constant gradient curve fitting technique is used. In either case, the word must begin in column 21. The last three fields of the THERMAL PROFILE card are numeric fields, each of which is read into the computer using an F10.5 format. The first numeric field contains the number of points in the profile and the second numeric field contains the latitude in degrees. The third numeric field may contain the salinity in parts per thousand, if the salinity is constant throughout the profile. If salinity varies with depth, this field may be left blank.

The second card of the temperature and salinity profile set is the units card which uses three fields of ten columns each, starting in columns 1, 11 and 21 respectively. The first field contains the units of depth, the second contains the units of temperature and the third indicates the units in which the resultant velocities are to be printed and/or plotted. Table 2 of reference (a), together with the following additions, is a complete list of acceptable input units, their CONGRATS abbreviations, their conversion factors and the resulting program units.

2		IDENTITY CODE
Better on file		
B.	GP	

<u>Input Units</u>	<u>Abbreviation</u>	<u>Conversion Factor</u>	<u>Result</u>
Centigrade	C	1.00000000	C
Fahrenheit	Fahr	0.55555555	C

Note: 32 must be subtracted from the number of degrees Fahrenheit before multiplication by the conversion factor.

The cards containing the temperature profile, arranged in order of increasing depth, follow the units card. These cards use three numeric fields, starting in columns 1, 11 and 21, of ten columns each: the first field contains the depth, the second contains the temperature, and the third contains the salinity. If the salinity is constant as a function of depth and the salinity field has been filled on the first card of the set, the third field of the profile cards may be left blank.

The possible choices for indicating the salinity are charted in Table 2. If the salinity field on each card of the temperature profile and the constant salinity field on the first card of the set are both left blank, then the salinity is considered to be zero parts per thousand throughout the profile. If the salinity field on each profile card is left blank but the constant salinity field on the first card of the set contains a positive number, then the salinity is considered constant and its value is the number indicated on the first card. In both cases the resultant constant salinity value is printed at each depth of the temperature and salinity profile in the computer print-out. If a positive value is shown in the third field of one or more profile cards, the constant salinity field of the first card is ignored and the resultant salinity profile consists entirely of the salinity values from the profile cards. It should be noted that a negative salinity will cause the program to terminate with an error stop.

The cards presented in Fig. 1 are an example of a temperature and salinity profile set. The first card indicates that the resultant velocity profile is to be fitted with continuous gradients, that there are 19 points in the profile, that the latitude is 39 degrees, and that the salinity, which is constant, is 38.2 parts per thousand. The second card indicates that depths are in feet, temperatures are in degrees Fahrenheit, and that the resultant velocities are to be printed in feet per second. The remaining cards contain the depths and temperatures of the profile. Salinity values are absent from these cards because the salinity is constant and indicated on the first card of the set.

An example of a temperature and salinity profile in which salinity varies with depth is presented in Fig. 2. The use of the continuous

gradient curve fitting technique is requested; there are 10 points in the profile, and the latitude is 40° . The depth units are feet, the temperature units are degrees Fahrenheit, and the velocity units are feet per second. Since salinity varies with depth, the profile cards indicate temperature and salinity for each depth and the salinity field on the first card of the set is left blank.

If a plot of temperature versus depth and/or salinity versus depth is desired, a THERMAL AXES card must be included in the input deck. This card contains the words "THERMAL" and "AXES" starting in columns 1 and 11, respectively. The third field contains the units in which the axes are to be plotted. Inches and centimeters are the available units. The fourth field, which is numeric, contains the length of the depth axis, which is plotted vertically. The numbers in the fifth and sixth fields are the lengths of the horizontal temperature and salinity axes, respectively. A zero temperature axis length or salinity axis length will suppress the temperature versus depth or salinity versus depth plot, respectively. Both plots will be suppressed if the depth axis length is zero. Figure 3(a) presents a THERMAL AXES card which would cause both a temperature and salinity profile to be plotted. The depth axis would be 10 inches long in both plots; the temperature axis, 8 inches long; and the salinity axis, 5 inches long. The card shown in Fig. 3(b) would cause only one plot to be drawn. The temperature versus depth plot would have a depth axis of 10 inches and a temperature axis of 6 inches, and the value of the salinity at the surface would be printed at the left of the plot. If the user desires other information plotted by the program, the appropriate AXES cards (as described in reference (a)) must be added for each type of plot, e.g., for a velocity profile plot to be drawn, a VELOCITY AXES card must be added to the input deck.

EXAMPLES

Two different sample runs have been selected to illustrate the use of a temperature and salinity profile in the CONGRATS series. Example 1 uses the temperature and salinity profile shown in Fig. 1. Figure 4 is a listing of the Example 1 run deck. The resultant computer print-out (see Fig. 5) shows the temperature and salinity profile with the constant salinity value, 38.2 parts per thousand, printed along with each depth and temperature of the profile. The latitude, which is 39° , is printed below the thermal profile. The velocity profile, which has been computed by the program, is listed, followed by the velocity tolerance used to fit the data. The THERMAL AXES card (see Fig. 3(b)) listed in Fig. 4 causes the temperature-depth profile to be drawn. The resultant plot is shown in Fig. 6. The surface salinity (which in this case is the salinity throughout the profile) is printed to the left of the temperature profile because the salinity plot has been suppressed. The generated velocity-depth profile is plotted in Fig. 7.

Example 2 uses the temperature and salinity profile presented in Fig. 2. The input deck (listed in Fig. 8) generates the computer print-out shown in Fig. 9 and calls for four plots: a temperature profile, a salinity profile, a velocity profile, and a ray trace (Figs. 10, 11, 12 and 13 respectively).

SUMMARY

The fundamental CONGRATS programs, S0990 and S0991, have been revised to accommodate temperature and salinity data, in addition to velocity data, as a function of depth. Velocity data is still an acceptable input, leaving the programs entirely compatible with old input decks. The ray plotting, eigenray generation and eigenray processing functions of the CONGRATS series (as described in references (a) and (b)) have not been affected by the addition of the new input set. Subroutine INPUT has been changed in order to read and interpret the THERMAL cards and a new subroutine, BT, has been written to convert the THERMAL PROFILE into a VELOCITY PROFILE. These two routines are listed in the appendix.

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REFERENCES

- (a) H. Weinberg, "CONGRATS I: Ray Plotting and Eigenray Generation," USL Report No. 1052, 31 October 1969.
- (b) J. S. Cohen and L. T. Einstein, "CONGRATS II: Eigenray Processing Programs," USL Report No. 1069 (being edited).
- (c) C. C. Leroy, "Development of Simple Equations for Accurate and More Realistic Calculation of the Speed of Sound in Sea Water," JASA 46, No. 1 (Part 2), July 1969, pp. 216-226.

TABLE 1

FORMULA FOR THE CALCULATION OF SOUND SPEED IN SEA WATER

COMPLETE $V = V_0 + V_a + V_b + V_c + V_d$

BASIC $V = V_0 + V_a$

in which

<u>Term</u>	<u>Conditions for Use of Term</u>
$V_0 = 1493 + 3(T - 10) - 6 \times 10^{-3}(T - 10)^2$ $- 4 \times 10^{-2}(T - 18)^2 + 1.2(S - 35)$ $- 10^{-2}(T - 18)(S - 35) + Z/61$	Always
$V_a = + 10^{-1}D^2 + 2 \times 10^{-4}D^2(T - 18)^2 + 10^{-1}D\phi/90$	Always
$V_b = 2.6 \times 10^{-4}T(T - 5)(T - 25)$	$T \geq 25^\circ\text{C}$
$V_c = - 10^{-3}D^2(D - 4)(D - 8)$	$Z > 7000 \text{ m}$
$V_d = 1.5 \times 10^{-3}(S - 35)^2(1 - D)$ $+ 3 \times 10^{-6}T^2(T - 30)(S - 35)$	$S < 30^\circ/\text{oo}$

where

V is the sound speed in m/s

T is the temperature in $^\circ\text{C}$

S is the salinity in $^\circ/\text{oo}$

Z is the depth in m , and $D = Z/1000$

ϕ is the latitude in degrees

NOTE: V_0 can also be written:

$$V_0 = 1449.44 - 4.56T - 0.046 T^2$$

$$+ 1.2(S - 35) - 10^{-2}(T - 18)(S - 35) + Z/61$$

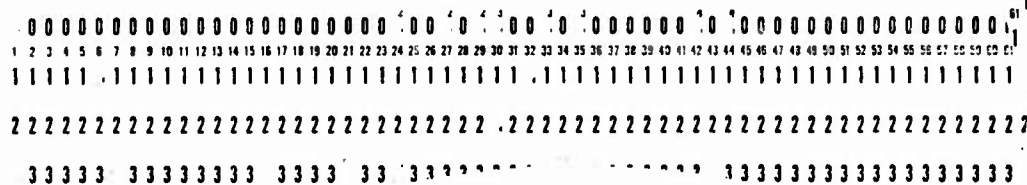
TABLE 2

Salinity Field on Profile Cards	Salinity Field on First Card of Set	Resultant Salinity
Zero	Zero	Constant Zero
Zero	Positive	Constant Positive
Positive	Zero	Profile of Values
Positive	Positive	Profile of Values

THERMAL PROFILE CONTINUOUS 19.0 39.0 38.2

33333 33333333 3333 33 333333 33333333

Fig. 1 - Temperature and Salinity Set 1



9

(a) Example 1

(b) Example 2

10

@ RUN A0011100,3,2071,S0991,FC,2,50 JSCOMEN
@ ASG X=U106
@ XQT CUR
IN X
TRI X
@ XQT S0991
COMMENT

		EXAMPLE 1			
THERMAL	PROFILE	CONTINUOUS	19.0	39.0	38.2
FT	FAHR	FT/S			
0.0	65.62				
32.808	65.21				
65.616	65.11				
98.424	65.16				
164.04	65.2				
246.06	61.16				
328.08	59.23				
492.12	57.10				
656.16	57.01				
984.24	57.27				
1312.32	57.24				
1640.4	57.15				
1968.48	57.06				
2624.64	56.76				
3280.8	56.33				
3936.96	56.17				
4921.2	55.91				
6561.6	55.78				
8202.0	55.77				
THERMAL	AXES	IN	10.0	6.0	
VELOCITY	TOLERANCE	FT/S	2.0		
VELOCITY	AXES	IN	10.0	7.0	
PROCESS					
END					
@ EOF					
@ FIN					

Fig. 4 - Listing of Example 1 Run Deck

EXAMPLE 1

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THERMAL PROFILE

CARD	DEPTH-FT	TEMPERATURE-FAHR	SALINITY-/1000	CARD	DEPTH-FT	TEMPERATURE-FAHR	SALINITY-/1000
1	.00	65.62	38.20	11	1312.32	57.24	38.20
2	32.81	65.21	38.20	12	1640.40	57.15	38.20
3	65.62	65.11	38.20	13	1968.48	57.06	38.20
4	98.42	65.16	38.20	14	2624.64	56.76	38.20
5	164.04	65.20	38.20	15	3280.80	56.33	38.20
6	240.00	61.16	38.20	16	3936.96	56.17	38.20
7	320.00	59.23	38.20	17	4921.20	55.91	38.20
8	492.12	57.10	38.20	18	6561.60	55.78	38.20
9	656.16	57.01	38.20	19	8202.00	55.77	38.20
10	984.24	57.27	38.20				

LATITUDE = 39.00000 DEGREES

VELOCITY PROFILE

CARD	DEPTH-FT	VELOCITY-FT/S	CARD	DEPTH-FT	VELOCITY-FT/S
1	.00	4994.68	11	1312.32	4970.12
2	32.81	4993.11	12	1640.40	4975.01
3	65.62	4993.13	13	1968.48	4979.91
4	98.42	4993.93	14	2624.64	4989.01
5	164.04	4995.22	15	3280.80	4997.35
6	240.00	4974.96	16	3936.96	5007.33
7	320.00	4965.45	17	4921.20	5022.22
8	492.12	4955.76	18	6561.60	5049.00
9	656.16	4957.93	19	8202.00	5075.68
10	984.24	4964.88			

GROUP	COORDINATE	UNITS	INITIAL	FINAL	INCREMENT
VELOCITY	TOLERANCE	FT/S	2.00	2.00	.00

Fig. 5 - Example 1 Computer Print-Out

SALINITY = 38.20000

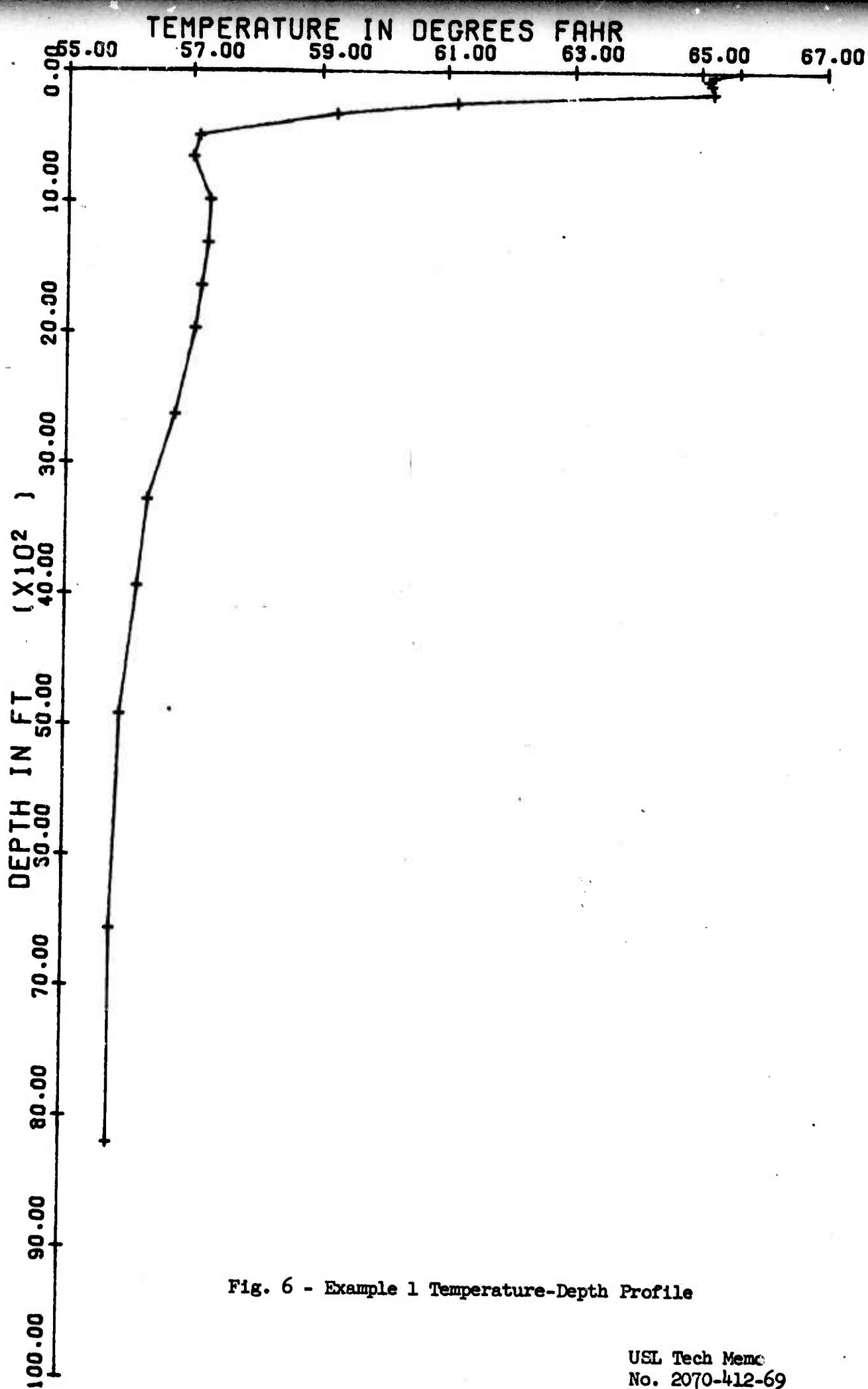


Fig. 6 - Example 1 Temperature-Depth Profile

VELOCITY TOLERANCE = 2.00000FT/S

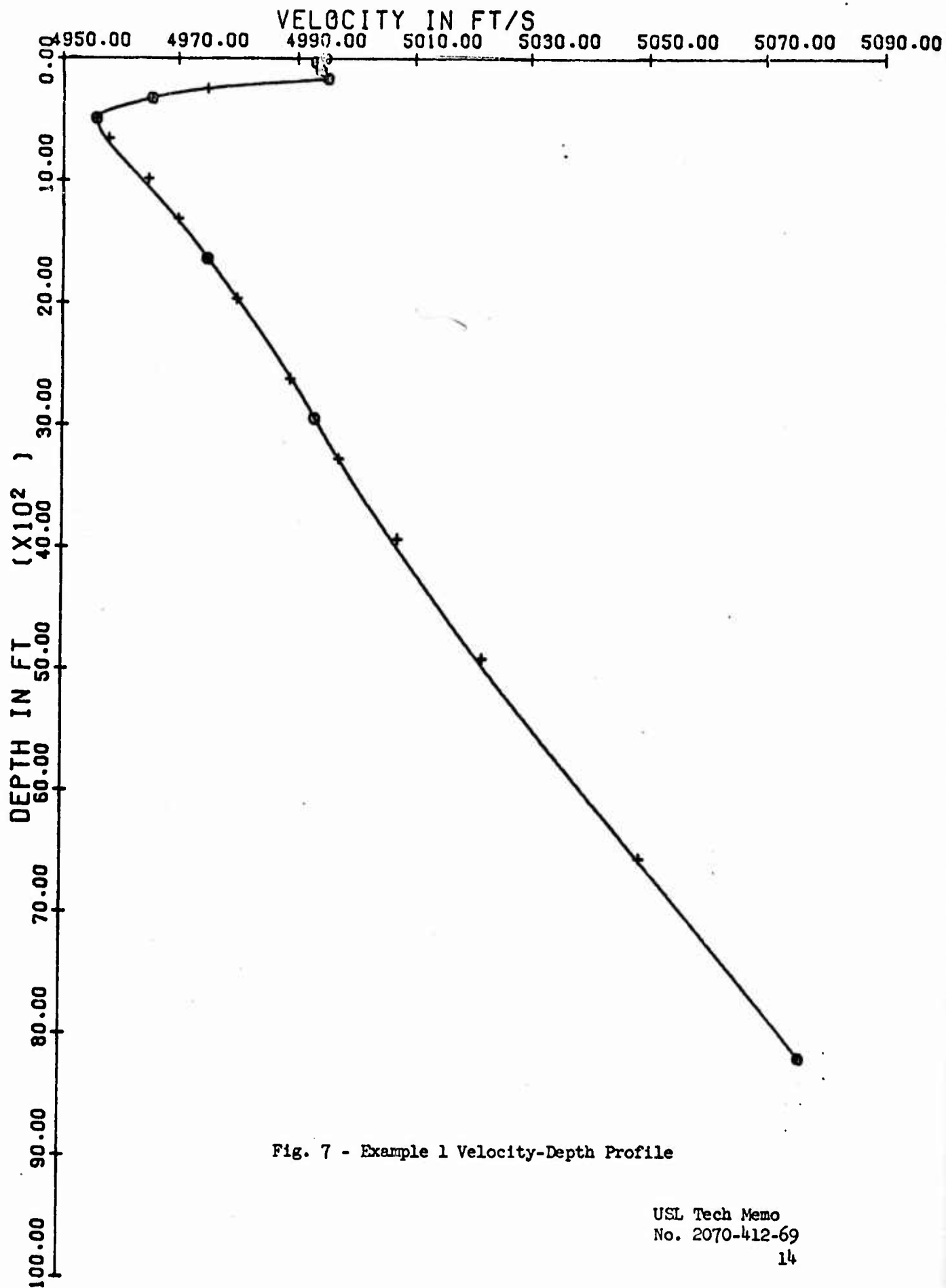


Fig. 7 - Example 1 Velocity-Depth Profile

@ RUN AU011100,3,2071,SU991,FC,2,50 JSCOHEN
@ ASG X=U106
@ XQT CUR
IN X
TR1 X
@ XQT SU991
COMMENT

		EXAMPLE 2			
THERMAL	PROFILE	CONTINUOUS	10.0	40.0	
FT	FAHR	FT/S			
0.0	67.0	37.81			
100.0	66.5	37.81			
246.06	58.6	37.8			
492.12	56.96	38.37			
656.16	57.16	38.55			
984.24	57.16	38.73			
1640.4	56.97	39.95			
4921.2	56.4	38.56			
8202.0	56.9	38.50			
11482.8	57.9	38.49			
THERMAL	AXES	IN	6.0	6.0	6.0
VELOCITY	TOLERANCE	FT/S	2.0		
VELOCITY	AXES	IN	6.0	6.0	
SONAR	ANGLE	DEG	2.0	13.5	0.10
SONAR	DEPTH	FT	20.0		
MAXIMUM	REVERSALS		10.0		
BOTTOM	PROFILE		2.0		
KYD	FT				
0.0	11480.0				
100.0	11480.0				
BOTTOM	AXES	IN	20.0	6.0	
PROCESS					
END					
@ EOF					
@ FIN					

Fig. 8 - Listing of Example 2 Run Deck

EXAMPLE 2

THERMAL PROFILE

CARD	DEPTH-FT	TEMPERATURE-FAHR	SALINITY-/1000	CARD	DEPTH-FT	TEMPERATURE-FAHR	SALINITY-/1000
1	.00	67.00	37.81	6	984.24	57.16	38.73
2	100.00	66.50	37.81	7	1640.40	56.97	39.95
3	246.06	58.60	37.80	8	4921.20	56.40	38.56
4	492.12	56.96	38.37	9	8202.00	56.90	38.50
5	656.16	57.16	38.55	10	11482.80	57.90	38.49

LATITUDE = 40.00000 DEGREES

VELOCITY PROFILE

CARD	DEPTH-FT	VELOCITY-FT/S	CARD	DEPTH-FT	VELOCITY-FT/S
1	.00	5000.14	6	984.24	4966.39
2	100.00	4999.27	7	1640.40	4981.07
3	246.06	4958.86	8	4921.20	5026.63
4	492.12	4955.63	9	8202.00	5084.65
5	656.16	4960.24	10	11482.80	5146.42

INCREMENT

INITIAL	FINAL
2.00	2.00
2.00000	13.50000
20.00	20.00
10.00000	10.00000

COORDINATE UNITS

GROUP	VELOCITY	TOLERANCE	ANGLE	DEPTH	REVERSALS
SONAR	SONAR	SONAR	SONAR	SONAR	SONAR
MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM	MAXIMUM

BOTTOM PROFILE

CARD	RANGE-KYD	DEPTH-FT	CARD	RANGE-KYD	DEPTH-FT
1	.00000	11480.00	2	100.00000	11480.00

Fig. 9 - Example 2 Computer Print-Out

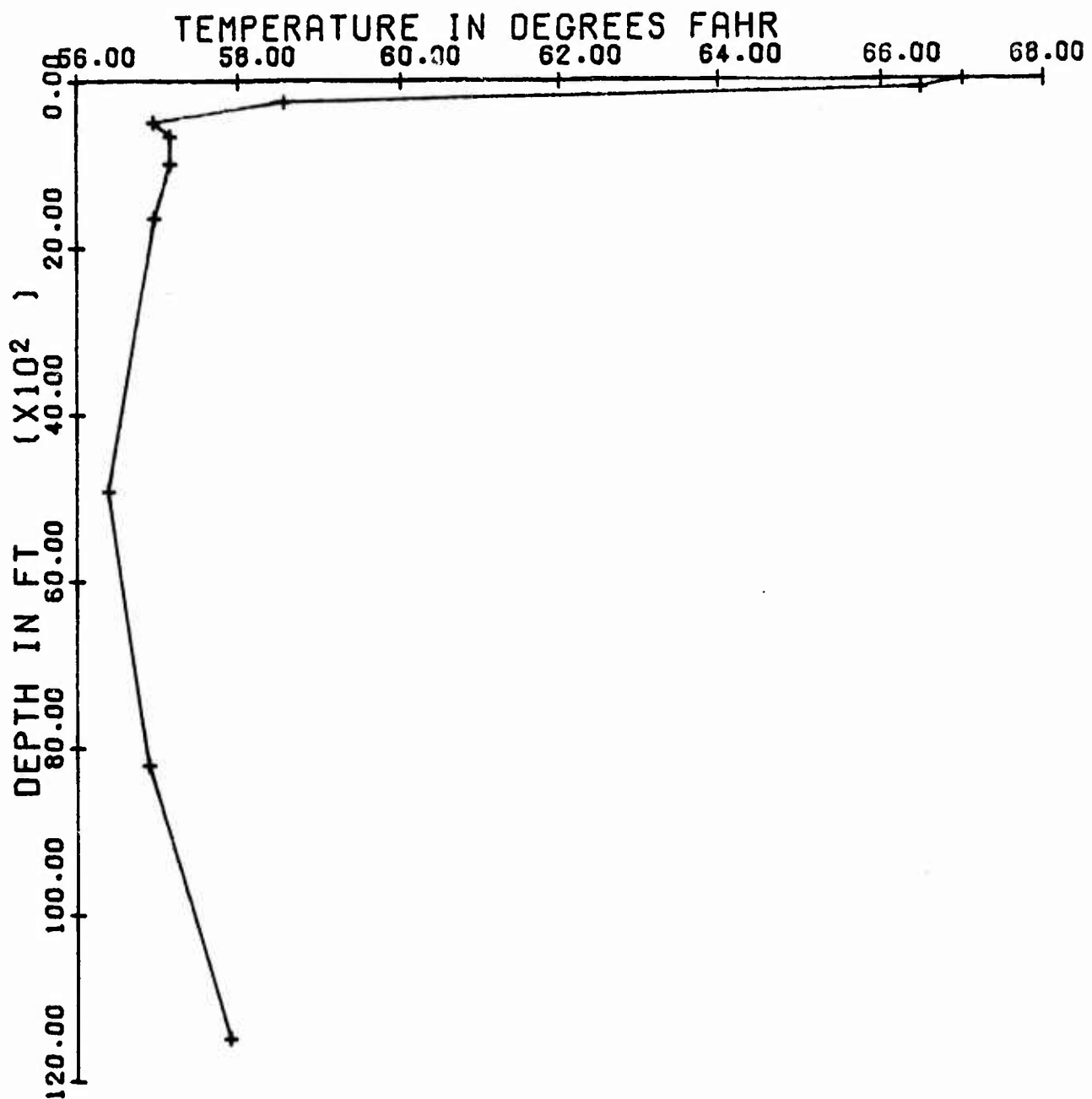


Fig. 10 - Example 2 Temperature-Depth Profile

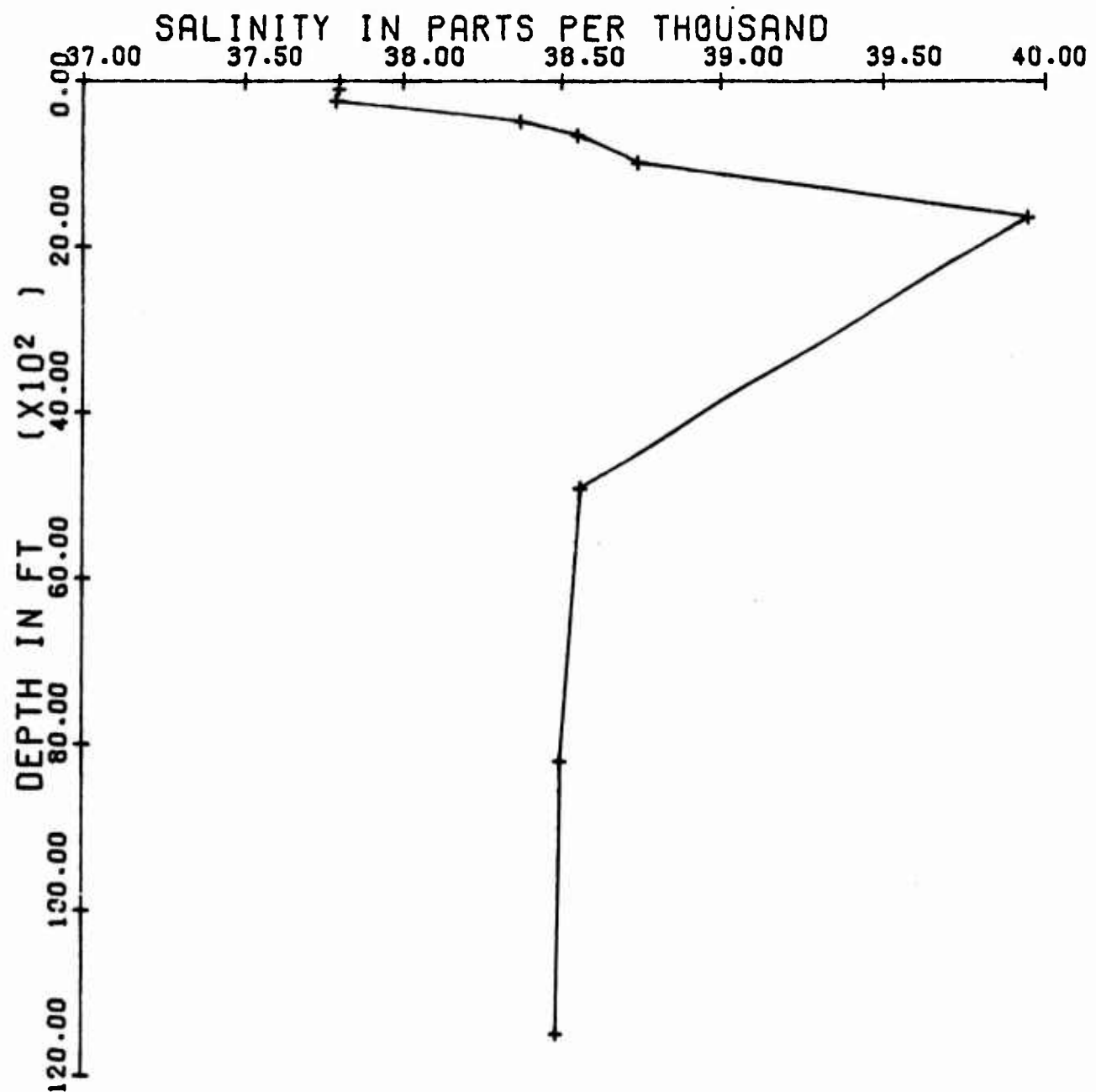


Fig. 11 - Example 2 Salinity-Depth Profile

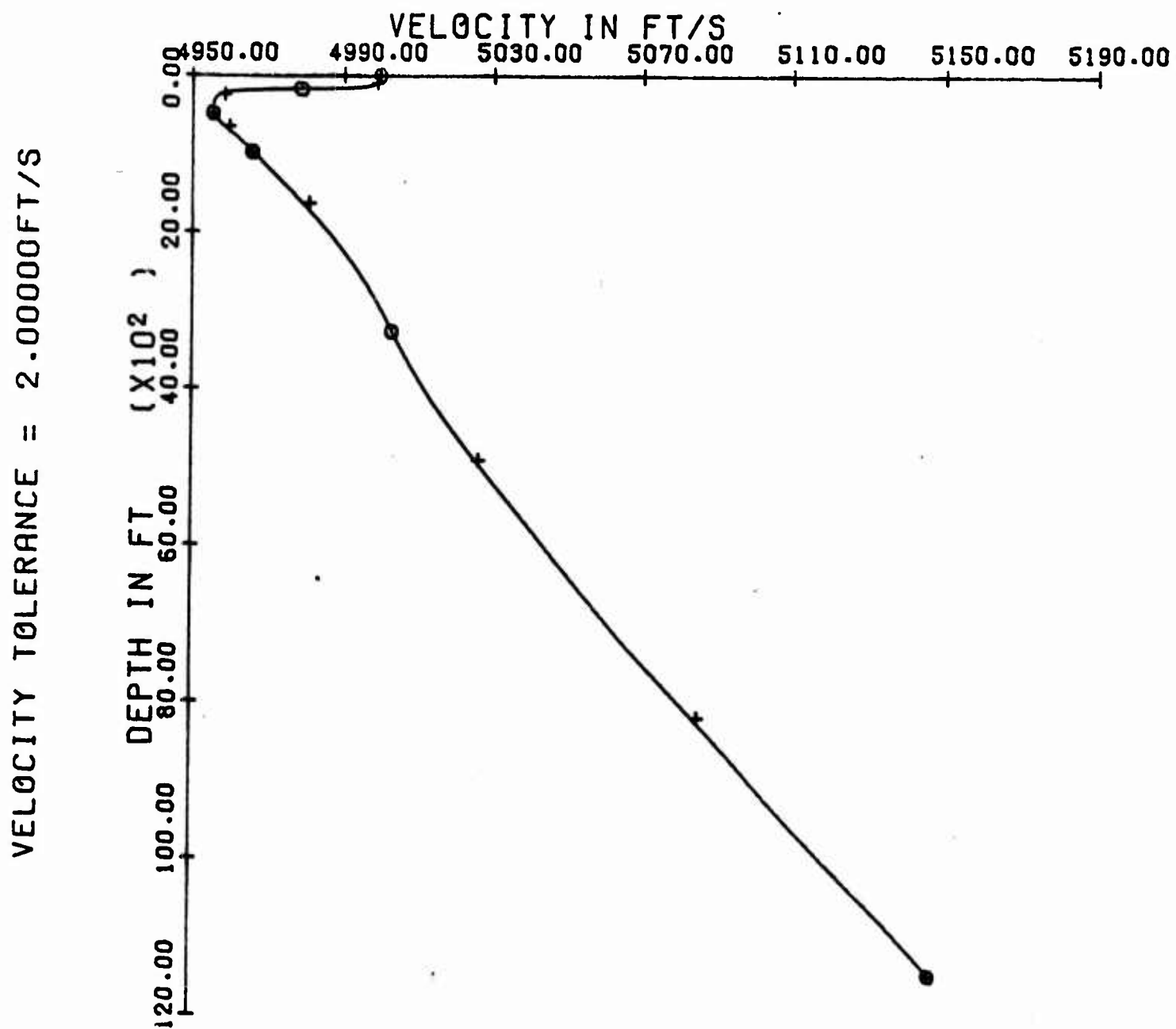


Fig. 12 - Example 2 Velocity-Depth Profile

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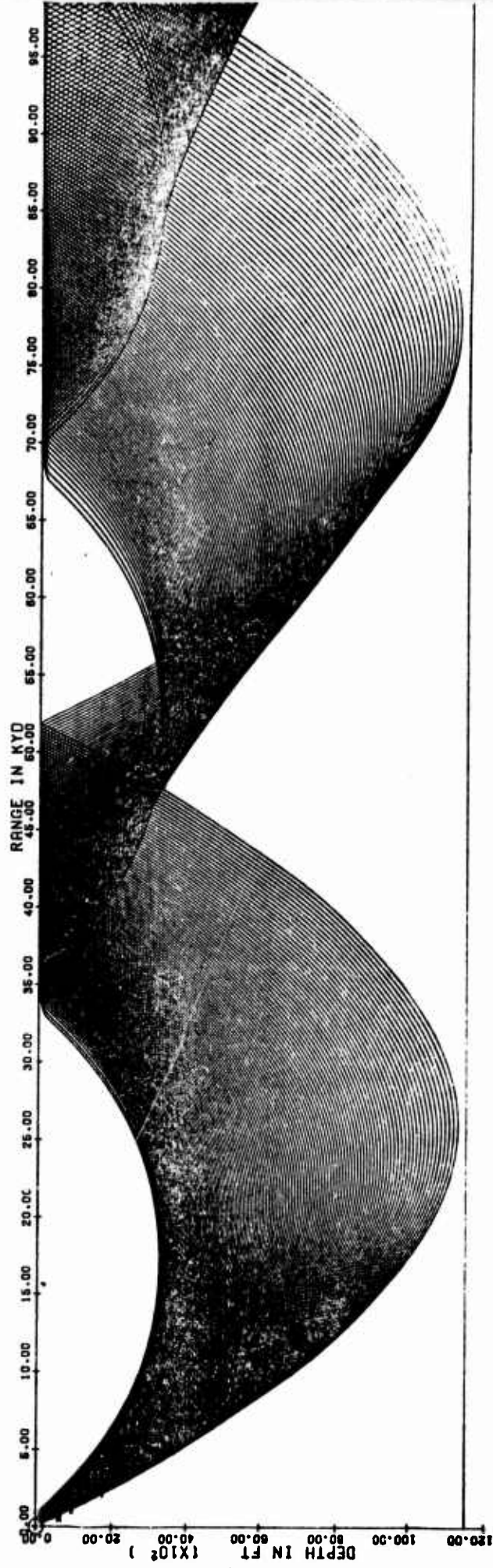


Fig. 13 - Example 2 Ray Plot

APPENDIX A

```

C
C SUBROUTINE BT CONVERTS A TEMPERATURE PROFILE TO A VELOCITY
C PROFILE.
C
C SUBROUTINE BT(TP)
C
C DIMENSION AND COMMON STATEMENTS.
C
C   DIMENSION TARGET(1010,3),ANGLES(1010),SONAR(5,2),SURFAC(5),
1 SP(210,2),BOTTOM(5),BP(210,2),TOLERA(5),VP(210,2),TP(210,3),
2 FMT(12)
C   COMMON TARGET,ANGLES,SONAR,SURFAC,SP,BOTTOM,BP,TOLERA,VP,
1 KEVMAX,PROCES
C   NCARDS = TP(210,1)
C
C   TRANSFER DEPTHS TO VP ARRAY.
C
C   DO 10 N=1,NCARDS
C     VP(N,1) = TP(N,1)
10  CONTINUE
C
C   CALCULATE VELOCITY FROM TEMPERATURE, DEPTH, LATITUDE, AND SALINITY.
C
C   DO 180 N=1,NCARDS
C
C   CONVERT DEPTH TO METERS.
C
C     Z = TP(N,1)*TP(204,1)/TP(204,3)
C     D = Z/1000
C     VO = 1449.44 + 4.56 * TP(N,2) - 0.046 * TP(N,2) * TP(N,2) + 1.2 *
1 (TP(N,3) - 35.0) - 0.01 * (TP(N,2) - 18.0) * (TP(N,3) - 35.0) +
2 Z/61.0
C     VA = 0.1 * D * D + 0.0002 * D * D * (TP(N,2) - 18.0)**2 + 0.1 *
1 D * TP(210,2)/90.0
C
C   TEST TEMPERATURE GREATER THAN OR EQUAL TO 25 DEG.C.
C
C     IF ( TP(N,2) - 25.0 ) 110, ,
C     VB = 0.00026 * TP(N,2) * (TP(N,2) - 5.0) * (TP(N,2) - 25.0)
C     GO TO 120
110  VB = 0
C
C   TEST DEPTH GREATER THAN 7000 M.
C
C     120 IF ( Z - 7000 ) 130, 130,
C     VC = -0.001 * D * D * (D-4.0) * (D-8.0)
C     GO TO 140
130  VC = 0
C
C   TEST SALINITY LESS THAN 30-/1000.
C
C     140 IF ( TP(N,3) - 30.0 ) , 150, 150
C     VD = 0.0015 * (1.0-D) * (TP(N,3) - 35.0)**2 + 0.000003 * TP(N,2)
1 * TP(N,2) * (TP(N,2) - 30.0) * (TP(N,3) - 35.0)
C     GO TO 160
150  VD = 0
160  VP(N,2) = VO + VA + VB + VC + VD
C

```



```

C      CONVERT VELOCITY TO DESIRED UNITS.
C
180    VP(N,2) = VP(N,2) * TP(205,3)/VP(204,2)
      CONTINUE
      GO TO 9000

C
C
C
C
C      BTPLLOT PLOTS TEMPERATURE PROFILE AND/OR SALINITY PROFILE.
C      -----
C
      ENTRY BTPLLOT(TP)
      IF ( TP(208,1) ) 9000, 9000,      @ TEST Z AXIS

C
C      COMPUTE THE SCALE FACTOR FOR THE DEPTH AXIS.
C
      CALL SCALE(TP(1,1),TP(208,1),NCARDS,1,TP(207,1))
      TP(NCARDS+1,1) = TP(NCARDS+1,1) + TP(NCARDS+2,1) * TP(208,1)
      TP(NCARDS+2,1) = -TP(NCARDS+2,1)
      IF ( TP(208,2) ) 5000, 5000,      @ TEST T AXIS

C
C      PLOT THE DEPTH AXIS IN THE ORIGINAL UNITS.
C      SET THE VARIABLE FORMAT
C
      FMT(1) = 6H DEP
      FMT(2) = 6H TH IN
      FMT(3) = TP(205,1)
      CALL AXIS(0.0,0.0,FMT,+18,TP(208,1),90.0,TP(NCARDS+1,1),
1 TP(NCARDS+2,1),TP(207,1))
      IF ( TP(208,3) ) , , 4120 @TEST S AXIS
      CALL SYMBOL(-1.0,1.0,0.14,12HSALINITY = ,90.0,12)
      CALL NUMBER(999.0,999.0,0.14,TP(1,3),90.0,5)

C
C      PLOT THE TEMPERATURE AXIS IN THE ORIGINAL UNITS.
C      CONVERT TEMPERATURE TO ORIGINAL UNITS.
C      COMPUTE THE SCALE FACTOR.
C
4120  IF ( TP(204,2) - 0.75 ) , , 4140
      DO 4130 N=1,NCARDS
4130  TP(N,2) = 32.0 + TP(N,2)/TP(204,2)
4140  CALL SCALE(TP(1,2),TP(208,2),NCARDS,1,TP(207,2))

C
C      SET THE VARIABLE FORMAT.
C
      FMT(1) = 6H TEMPE
      FMT(2) = 6H RATURE
      FMT(3) = 6H IN DE
      FMT(4) = 6H GREES
      FMT(5) = TP(205,2)
      CALL AXIS(0.0,TP(208,1),FMT,+30,TP(208,2),0.0,TP(NCARDS+1,2),
1 TP(NCARDS+2,2),TP(207,2))

C
C      PLOT THE TEMPERATURE PROFILE.
C
      CALL LINE ( TP(1,2),TP(1,1),NCARDS,1,1,3)
      CALL PLOT (TP(208,2)+5.0,0.0,-3)

C
C      PLOT SALINITY PROFILE.

```

```
C
5000 IF ( TP(208,3) ) 9000, 9000,    Q TEST S AXIS
C
C      PLOT DEPTH AXIS FOR SALINITY PROFILE.
C      SET THE VARIABLE FORMAT
C
      FMT(1) = 6H DEP
      FMT(2) = 6H TH IN
      FMT(3) = TP(205,1)
      CALL AXIS (0.0,0.0,FMT,+18,TP(208,1),90.0,TP(NCARDS+1,1),
1 TP(NCARDS+2,1),TP(207,1))
C
C      PLOT THE SALINITY AXIS
C      COMPUTE THE SCALE FACTOR.
C
      CALL SCALE(TP(1,3),TP(208,3),NCARDS,1,TP(207,3))
C
C      SET THE VARIABLE FORMAT.
C
      FMT(1) = 6HSALINI
      FMT(2) = 6HTY IN
      FMT(3) = 6HPARTS
      FMT(4) = 6HPER TH
      FMT(5) = 6HOUSAND
      CALL AXIS(0.0,TP(208,1),FMT,+30,TP(208,3),0.0,TP(NCARDS+1,3),
1 TP(NCARDS+2,3),TP(207,3))
C
C      PLOT THE SALINITY PROFILE.
C
      CALL LINE (TP(1,3),TP(1,1),NCARDS,1,1,3)
      CALL PLOT(TP(208,3)+5.0,0.0,-3)
9000 RETURN
      END
```

```

C      SUBROUTINE INPUT FOR CONGRATS.                                CHIC WEINBERG
C      -----
C
C      SUBROUTINE INPUT
C
C      DIMENSION TARGET(1010,3),ANGLES(1010),SONAR(5,2),SURFAC(5),
1 SP(210,2),BOTTOM(5),BP(210,2),TOLERA(5),VP(210,2),TP(210,3)
      DIMENSION GROUP(11)/66HCOMMENTARGETISONAR SURFACBOTTOMVELOCITHERMA
1PROCESEND FREQUEMAXIMU/
      DIMENSION COORD(8)/48HRANGE DEPTH ANGLE LOSS TOLERAAXES PROFILP
1HASE /
      DIMENSION UNITS(2,32)/
1  1.09361111E-5, 6HCM      ,      1.09361111E-5, 6HCM/S      ,
2  2.77777777E-5, 6HIN      ,      2.77777777E-5, 6HIN/S      ,
3  0.33333333E-3, 6HFT      ,      0.33333333E-3, 6HFT/S      ,
4  1.00000000E-3, 6HYD      ,      1.00000000E-3, 6HYD/S      ,
5  1.09361111E-3, 6HM      ,      1.09361111E-3, 6HM/S      ,
6  2.00000000E-3, 6HF      ,      2.00000000E-3, 6HF/S      ,
7  0.33333333E-0, 6HKFT      ,      0.33333333E-0, 6HKFT/S      ,
8  1.00000000E-0, 6HKYD      ,      1.00000000E-0, 6HKYD/S      ,
9  1.09361111E-0, 6HKM      ,      1.09361111E-0, 6HKM/S      ,
T  1.76000000E-0, 6HMI      ,      1.76000000E-0, 6HMI/S      ,
1  2.02680000E-0, 6HNI MI      ,      2.02680000E-0, 6HNI MI/S      ,
2  1.74532925E-2, 6HDEG      ,      1.74532925E-2, 6HDEG/S      ,
3  1.00000000E-0, 6HRAD      ,      1.00000000E-0, 6HRAD/S      ,
4  6.28318531E-0, 6HCPS      ,      6.28318531E+3, 6HCPS      ,
5  1.00000000E-3, 6HMS      ,      1.00000000E-0, 6HSEC      ,
6  1.00000000E-0, 6HC      ,      5.55555555E-1, 6HFAHR /
      DIMENSION TEST(12),FMT(12),DATA(2048),REVMAX(4)
      DIMENSION CMMNT(12)/72H THERE SHOULD BE AT LEAST ONE COMMENT SET
1.
      DATA PRINT/6HPRINT //,LINMAX/60//,ICMMNT/0/
      COMMON TARGET,ANGLES,SONAR,SURFAC,SP,BOTTOM,BP,TOLERA,VP,
1 REVMAX,PROCES
C
C
C
C
C      SET INITIAL CONDITIONS.
C      -----
      ANGLES(1010) = 0.0
      TARGET(1010,1) = 0.0
      TARGET(1010,2) = 0.0
      IHEAD = 0
      LINES = LINMAX
      NPRINT = FLD(33,3,PROCES)
      NTAPE1 = FLD(30,3,PROCES)
      NTAPE2 = FLD(27,3,PROCES)
C
C
C
C
C      CHECK THE GROUP CODE.
C      -----
100 READ 101, (TEST(J),J=1,9)
101 FORMAT( 3(A6,A4), 3F10.5 )
      DO 110 I=1,11
      IF( TEST(1).GT.GROUP(I) .OR. TEST(1).LT.GROUP(I) ) GO TO 110
      IGROUP = I

```

```

GO TO (1000,200,200,200,200,200,200,8000,9000,300,9200), IGROUP
110 CONTINUE
C
C THE GROUP CODE IS INCORRECT.
120 FMT(1) = (+6HGROUP )
130 PRINT 132, FMT(1)
132 FORMAT( 10X 14HTHE FOLLOWING , A6, 18HCODE IS INCORRECT. )
140 PRINT 142, ( TEST(J),J=1,9 )
142 FORMAT( 24X 6A6, 3F12.5 )
150 PRINT 152
152 FORMAT( 10X 28HTHE PROGRAM CANNOT CONTINUE. )
STOP 6

C
C
C CHECK THE COORD CODE.
-----C
200 DO 210 I=1,8
IF( TEST(3).GT.COORD(I) .OR. TEST(3).LT.COORD(I) ) GO TO 210
ICoord = I
GO TO (300,300,300,500,300,300,600,500), ICoord
210 CONTINUE

C
C THE COORD CODE IS INCORRECT.
FMT(1) = (+6HCOORD )
GO TO 130

C
C
C CHECK THE UNITS CODE.
-----C
300 DO 310 I=1,30
IF( TEST(5).GT.UNITS(2,I) .OR. TEST(5).LT.UNITS(2,I) ) GO TO 310
IUnits = I
IF( IGROUP.EQ.10 ) GO TO 320
IF( ICoord.GE.6 ) GO TO 400
IF( TEST(9) ) 305,315,305
305 NCARDS = (TEST(8)-TEST(7))/TEST(9) + 1.5
IF( NCARDS*(1001-NCARDS) ) 2100,2100,320
310 CONTINUE

C
C THE UNITS CODE IS INCORRECT.
FMT(1) = (+6HUNITS )
GO TO 130

C
C PRINT THE DATA.
315 TEST(8) = TEST(7)
NCARDS = 1
320 IF( LINES.LT.LINMAX-5 ) GO TO 330
PRINT 322
322 FORMAT( 1H1 )
LINES = 1
GO TO 340
330 IF( IHEAD.EQ.1 ) GO TO 350
PRINT 332
332 FORMAT( // )
LINES = LINES + 3
340 PRINT 342
342 FORMAT( 25X 73HGROUP COORDINATE UNITS INITIAL
1 FINAL INCREMENT, / )

```

```

      LINES = LINES + 2
      IHEAD = 1
C
C      SET THE VARIABLE FORMAT.
350  FMT(1) = (+6H( 24X )
      FMT(2) = (+6H6A6, 3)
      IF( UNITS(1,IUNITS).GT.2.0E-3 ) GO TO 360
      FMT(3) = (+6HF12.2))
      GO TO 370
360  FMT(3) = (+6HF12.5))
370  PRINT FMT, (TEST(J),J=1,9)
      LINES = LINES + 1
      TEST(7) = TEST(7) * UNITS(1,IUNITS)
      TEST(8) = TEST(8) * UNITS(1,IUNITS)
      TEST(9) = TEST(9) * UNITS(1,IUNITS)
      GO TO (380,2000,3000,4000,5000,6000,380,380,380,9100,100), IGROUP
C
C      THE CODES ARE INCONSISTENT.
380  PRINT 382
382  FORMAT( 10X 33HTHE ABOVE CODES ARE INCONSISTENT. )
      GO TO 150
C
C
C      CHECK THE AXES CARD.
C      -----
400  IF( NTAPE1.EQ.0 ) NTAPE1=1
      IF( IUNITS.GT.4 ) GO TO 420
      IPAPER = 600 - 500 * ((IUNITS-1)/2)
      DO 410 J=1,3
      IF( TEST(J+6) * (100.0*UNITS(1,3)-TEST(J+6)*UNITS(1,IUNITS)) )
1 420,410,410
410  CONTINUE
      GO TO (420,420,420,4100,5100,6100,7100,420,420), IGROUP
C
C      THE AXES CARD IS INCORRECT.
420  PRINT 422
422  FORMAT( 10X 37HTHE FOLLOWING AXES CARD IS INCORRECT. )
      GO TO 140
C
C
C      READ THE LOSS TABLE.
C      -----
500  IHEAD = 0
      LINES = LINES + 28
      IF( LINES.LT.LINMAX-5 ) GO TO 510
      PRINT 322
      LINES = 25
      GO TO 520
510  PRINT 332
520  IF( IGROUP.EQ.4 ) GO TO 540
      IF( IGROUP.NE.5 ) GO TO 120
      IF( ICOORD.EQ.4 ) GO TO 530
      TEST(12) = BPHASE(FREQ)
      GO TO 100
530  TEST(12) = BLOSS(FREQ)
      GO TO 100
540  IF( ICOORD.EQ.4 ) GO TO 550
      TEST(12) = SPHASE(FREQ)

```



```

GO TO 100
550 TEST(12) = SLOSS(FREQ)
GO TO 100

C
C
C CHECK THE NUMBER OF CARDS IN THE PROFILE.
C -----
600 NCARDS = TEST(7)
IF( (NCARDS.GE.2).AND.(200.GE.NCARDS) ) GO TO 610
PRINT 602, (TEST(J),J=1,4), NCARDS
602 FORMAT( 10X 27HTHE NUMBER OF CARDS IN THE , 2(A6,A4),
1 110, 44H, EXCEEDS 200 CARDS OR IS LESS THAN 2 CARDS. )
GO TO 150

C
C PRINT THE HEADING.
610 IHEAD = 0
LINES = NCARDS/2 + 10 + LINES
IF( LINES.LT.LINMAX-1 ) GO TO 620
PRINT 322
LINES = NCARDS/2 + 6
GO TO 630
620 PRINT 332
630 PRINT 632, (TEST(J),J=1,4)
632 FORMAT( 51X 2(A6,A4), /, 51X 17H-----, / )

C
C
C CHECK THE UNITS CODE.
C -----
700 READ 101, TEST(1),TEST(10),TEST(2),TEST(11),TEST(3),TEST(12)
J = 1
710 DO 730 I=1,32
IF( TEST(J).GT.UNITS(2,I) .OR. TEST(J).LT.UNITS(2,I) ) GO TO 730
IF( J.GT.1 ) GO TO 720
IUNITS = I
J = 2
GO TO 710
720 IF (J.GT. 2) GO TO 725
JUNITS = I
J = 3
IF (IGROUP .EQ. 7) GO TO 710
GO TO 740
725 KUNITS = I
GO TO 740
730 CONTINUE

C
C THE UNITS CODE IS INCORRECT.
FMT(1) = (+6HUNITS )
PRINT 132, FMT(1)
PRINT 142, TEST(1),TEST(3),TEST(2),TEST(4)
GO TO 150

C
C SET THE VARIABLE FORMAT.
740 FMT(1) = (+6H( 2( )
FMT(2) = (+6H I15, )
IF( UNITS(1,IUNITS).GT.2.0E-3 ) GO TO 750
FMT(3) = (+6HF14.2, )
GO TO 760
750 FMT(3) = (+6HF14.5, )

```

```

760 IF (IGROUP .EQ. 7) GO TO 763 .
    LUNITS = JUNIT5
    GO TO 765
763 LUNITS = KUNIT5
765 IF ( UNITS(1,LUNITS) .GT. 2.0E-3 ) GO TO 770
    FMT(4) = (+6HF16.2,)
    GO TO 780
770 FMT(4) = (+6HF16.5,)
780 FMT(5) = (+6H15X) )
    GO TO (380,380,380,4200,5200,6200,7200,380,380), IGROUP

C
C
C
C
C
    READ AND WRITE A COMMENT CARD.
    -----
1000 READ 1001, (TEST(J),J=1,12)
1001 FORMAT( 12A6 )
1002 FORMAT( 10X 12A6 )
    IF( LINES.LT.LINMAX ) GO TO 1005
    PRINT 322
    LINES = 1
1005 PRINT 1002, (TEST(J),J=1,12)
    LINES = LINES + 1
    ICMMNT = ICMMNT + 1
    IF( ICMMNT.GT.1 ) GO TO 100
    DO 1010 J=1,12
1010 CMMENT(J) = TEST(J)
    GO TO 100

C
C
C
C
C
    CONVERT AND STORE THE TARGET DATA.
    -----
2000 IF( ICOORD.GT.2 ) GO TO 380
    IF( NTAPE2.EQ.0 ) NTAPE2=1
    TARGET(1004,ICOORD) = UNITS(1,IUNITS)
    TARGET(1005,ICOORD) = UNITS(2,IUNITS)
    N = TARGET(1010,ICOORD)
    NCARDS = N + 1
    IF( NCARDS.GT.1000 ) GO TO 2100
    TARGET(1010,ICOORD) = NCARDS
    N = N + 1
    DO 2010 I=N,NCARDS
2010 TARGET(I,ICOORD) = TEST(7) + (I-N)*TEST(9)
    GO TO 100

C
C
    THE NUMBER OF ENTRIES HAS BEEN EXCEEDED.
2100 PRINT 2102, GROUP(IGROUP), COORD(ICOORD)
2102 FORMAT( 10X 14HTHE NUMBER OF , A6, 1XA5,
1 23HS EXCEEDS 1000 ENTRIES. )
    GO TO 150

C
C
C
C
C
    CONVERT AND STORE THE SONAR DATA.
    -----
3000 IF( ICOORD=3 ) 3100,3200,380
3100 SONAR(1,ICOORD) = TEST(7)

```

```

SONAR(2,ICCOORD) = TEST(8)
SONAR(3,ICCOORD) = TEST(9)
SONAR(4,ICCOORD) = UNITS(1,IUNITS)
SONAR(5,ICCOORD) = UNITS(2,IUNITS)
GO TO 100

C
C   STORE THE SONAR ANGLE DATA.
3200 IF( ABS(TEST(7)).GT.1.5707 .OR. TEST(8).GT.1.5707 ) GO TO 3300
      ANGLES(1004) = UNITS(1,IUNITS)
      ANGLES(1005) = UNITS(2,IUNITS)
      N = ANGLES(1010)
      NCARDS = N + NCARDS
      IF( NCARDS.GT.1000 ) GO TO 2100
      ANGLES(1010) = NCARDS
      N = N + 1
      DO 3210 I=N,NCARDS
3210  ANGLES(I) = TEST(7) + (I-N)*TEST(9)
      GO TO 100

C
C   THE SONAR ANGLES EXCEED THEIR BOUNDS.
3300 PRINT 3302
3302  FORMAT(10X,50HALL SONAR ANGLES MUST LIE BETWEEN -90 AND +90 DEG.)
      GO TO 150

C
C
C
C
C   CONVERT AND STORE THE SURFACE DATA.
-----
4000 IF( ICCOORD.NE.2 ) GO TO 380
      SURFAC(1) = TEST(7)
      SURFAC(2) = TEST(8)
      SURFAC(3) = TEST(9)
      SURFAC(4) = UNITS(1,IUNITS)
      SURFAC(5) = UNITS(2,IUNITS)
      GO TO 100

C
C   STORE THE SURFACE AXES DATA.
4100 SP(207,1) = 2.77777777E-4/UNITS(1,IUNITS)
      SP(207,2) = SP(207,1)
      SP(208,1) = TEST(7)
      SP(208,2) = TEST(8)
      GO TO 5100

C
C
C
C   READ AND PRINT THE SURFACE PROFILE.
-----
4200 SP(204,1) = UNITS(1,IUNITS)
      SP(205,1) = UNITS(2,IUNITS)
      SP(204,2) = UNITS(1,IUNITS)
      SP(205,2) = UNITS(2,IUNITS)
      SP(210,1) = NCARDS
      SP(210,2) = TEST(5)
      SURFAC(4) = 0.0
      PRINT 4202, SP(205,1),SP(205,2),SP(205,1),SP(205,2)
4202  FORMAT( 2(12X 16HCARD RANGE=, A6, 9H DEPTH=, A6, 11X), / )
      READ 4212, (SP(N,1),SP(N,2),N=1,NCARDS)
4212  FORMAT( 2F10.5 )
      J = ( NCARDS + 1 ) / 2

```

```

DO 4220 L=1,J
N = L + J
IF( N.LE.NCARDS ) GO TO 4220
PRINT FMT, L,SP(L,1),SP(L,2)
GO TO 4230
4220 PRINT FMT, L,SP(L,1),SP(L,2), N,SP(N,1),SP(N,2)
C
C CONVERT AND CHECK THE PROFILE.
4230 DO 4260 N=1,NCARDS
SP(N,1) = SP(N,1) * SP(204,1)
SP(N,2) = SP(N,2) * SP(204,2)
C
C IS THE RANGE INCREASING.
IF( N.EQ.1 ) GO TO 4260
IF( SP(N,1).GT.SP(N-1,1) ) GO TO 4260
NCARDS = N
GO TO 4270
4260 CONTINUE
GO TO 100
C
C A CARD IS INCORRECT OR OUT OF ORDER.
4270 PRINT 4272, NCARDS
4272 FORMAT( 10X 11HCARD NUMBER, I4, 13HIS INCORRECT. )
GO TO 150
C
C
C
C
C CONVERT AND STORE THE BOTTOM DATA.
-----
5000 IF( ICOORD.NE.2 ) GO TO 380
BOTTOM(1) = TEST(7)
BOTTOM(2) = TEST(8)
BOTTOM(3) = TEST(9)
BOTTOM(4) = UNITS(1,IUNITS)
BOTTOM(5) = UNITS(2,IUNITS)
GO TO 100
C
C STORE THE BOTTOM AXES DATA.
5100 BP(207,1) = 2.777777777E-4/UNITS(1,IUNITS)
BP(207,2) = BP(207,1)
BP(208,1) = TEST(7)
BP(208,2) = TEST(8)
GO TO 100
C
C
C
C READ AND PRINT THE BOTTOM PROFILE.
-----
5200 BP(204,1) = UNITS(1,IUNITS)
BP(205,1) = UNITS(2,IUNITS)
BP(204,2) = UNITS(1,JUNITS)
BP(205,2) = UNITS(2,JUNITS)
BP(210,1) = NCARDS
BP(210,2) = TEST(5)
BOTTOM(4) = 0.0
PRINT 4202, BP(205,1),BP(205,2),BP(205,1),BP(205,2)
READ 4212, (BP(N,1),BP(N,2),N=1,NCARDS)
J = ( NCARDS + 1 ) / 2
DO 5220 L=1,J

```

```

N = L + J
IF( N.LE.NCARDS ) GO TO 5220
PRINT FMT, L,BP(L,1),BP(L,2)
GO TO 5230
5220 PRINT FMT, L,BP(L,1),BP(L,2), N,BP(N,1),BP(N,2)
C
C CONVERT AND CHECK THE PROFILE.
5230 DO 5260 N=1,NCARDS
BP(N,1) = BP(N,1) * BP(204,1)
BP(N,2) = BP(N,2) * BP(204,2)
C
C IS THE RANGE INCREASING.
IF( N.EQ.1 ) GO TO 5260
IF( BP(N,1).GT.BP(N-1,1) ) GO TO 5260
NCARDS = N
GO TO 4270
5260 CONTINUE
GO TO 100

C
C
C
C CONVERT AND STORE THE VELOCITY DATA.
-----
6000 IF( ICOORD.NE.5 ) GO TO 380
TOLERA(1) = TEST(7)
TOLERA(2) = TEST(8)
TOLERA(3) = TEST(9)
TOLERA(4) = UNITS(1,IUNITS)
TOLERA(5) = UNITS(2,IUNITS)
GO TO 100

C
C STORE THE VELOCITY AXES DATA.
6100 VP(207,1) = 2.777777777E-4/UNITS(1,IUNITS)
VP(207,2) = VP(207,1)
VP(208,1) = TEST(7)
VP(208,2) = TEST(8)
GO TO 100

C
C
C READ AND PRINT THE VELOCITY PROFILE.
-----
6200 VP(204,1) = UNITS(1,IUNITS)
VP(205,1) = UNITS(2,IUNITS)
VP(204,2) = UNITS(1,JUNITS)
VP(205,2) = UNITS(2,JUNITS)
VP(210,1) = NCARDS
VP(210,2) = TEST(5)
PRINT 6202, VP(205,1),VP(205,2),VP(205,1),VP(205,2)
6202 FORMAT(2(12X 16HCARD DEPTH-, A6, 10H VELOCITY-, A6, 10X), /)
READ 4212, (VP(N,1),VP(N,2),N=1,NCARDS)
6210 J = ( NCARDS + 1 ) / 2
DO 6220 L=1,J
N = L + J
IF( N.LE.NCARDS ) GO TO 6220
PRINT FMT, L,VP(L,1),VP(L,2)
GO TO 6230
6220 PRINT FMT, L,VP(L,1),VP(L,2), N,VP(N,1),VP(N,2)
C

```

```

C      CONVERT AND CHECK THE PROFILE.
6230  DO 6260 N=1,NCARDS
      VP(N,1) = VP(N,1) * VP(204,1)
      VP(N,2) = VP(N,2) * VP(204,2)
      IF( VP(N,2).GT.1.55 .AND. 1.77.GT.VP(N,2) ) GO TO 6240

C
C      THE VELOCITY EXCEEDS ITS BOUNDS.
      PRINT 6232, N
6232  FORMAT( 10X 28HVELOCITY PROFILE CARD NUMBER, I4,
1      20H EXCEEDS ITS BOUNDS. )
      GO TO 150

C
C      IS THE DEPTH INCREASING.
6240  IF( N.EQ.1 ) GO TO 6260
      IF( VP(N,1).GT.VP(N-1,1) ) GO TO 6260
      NCARDS = N
      GO TO 4270
6260  CONTINUE
      GO TO 100

C
C
C
C
C
C
C      CONVERT AND STORE TEMPERATURE DATA.
      -----

C
C      STORE THE THERMAL AXES DATA.
7100  TP(207,1) = 2.777777777E-4/UNITS(1,IUNITS)
      TP(207,2) = TP(207,1)
      TP(207,3) = TP(207,1)
      TP(208,1) = TEST (7)
      TP(208,2) = TEST (8)
      TP(208,3) = TEST (9)
      GO TO 100

C
C
C
C      READ AND PRINT THE THERMAL PROFILE.
      -----

C
7200  VP(204,1) = UNITS(1,IUNITS)
      VP(205,1) = UNITS(2,IUNITS)
      VP(204,2) = UNITS(1,KUNITS)
      VP(205,2) = UNITS(2,KUNITS)
      VP(210,1) = NCARDS
      VP(210,2) = TEST(5)
      TP(204,1) = UNITS(1,IUNITS)
      TP(205,1) = UNITS(2,IUNITS)
      TP(204,2) = UNITS(1,JUNITS)
      TP(205,2) = UNITS(2,JUNITS)
      TP(204,3) = UNITS(1,9)
      TP(205,3) = UNITS(1,10)
      TP(210,1) = NCARDS
      TP(210,2) = TEST(8)
      TP(210,3) = TEST (9)
      PRINT 7202, TP(205,1),TP(205,2),TP(205,1),TP(205,2)
7202  FORMAT(2(6X,16HCARD      DEPTH-,A6,12HTEMPERATURE-,A6,14HSALINITY
1-/1000,6X),/)
      READ 7205, (TP(N,1),TP(N,2),TP(N,3),N=1,NCARDS)
7205  FORMAT(3F10.5)

```

```

C
C   TEST WHICH SALINITY INPUT TO USE.
C
    SAL = 0.0
    DO 7207 I = 1, NCARDS
    IF ( TP(I,3) ) 7208, ,
    SAL = SAL + TP(I,3)
    IF (SAL .GT. 0.0) GO TO 7215
7207 CONTINUE
    GO TO 7210
7208 PRINT 7237, I
    PRINT 7209
7209 FORMAT (10X,36HNEGATIVE SALINITY IS NOT VALID DATA.)
    GO TO 150
7210 DO 7212 I = 1, NCARDS
    TP(I,3) = TP(210,3)
7212 CONTINUE
C
C   PRINT THE TEMPERATURE PROFILE.
C
7215 J = ( NCARDS + 1 )/2
    DO 7220 L=1,J
    N = L + J
    IF (N .LE. NCARDS) GO TO 7220
    PRINT 7225, L, TP(L,1), TP(L,2), TP(L,3)
    GO TO 7226
7220 PRINT 7225, L, TP(L,1), TP(L,2), TP(L,3), N, TP(N,1), TP(N,2), TP(N,3)
7225 FORMAT(2(6X,I3,6X,F8.2,8X,F7.2,11X,F7.2,10X))
7226 PRINT 7227, TP(210,2)
7227 FORMAT(//,45X,12HLATITUDE = ,F10.5,6H DEGREES,/)
C
C   CONVERT AND CHECK TEMPERATURE PROFILE
C
7230 DO 7260 N=1, NCARDS
    IF (JUNITS .EQ. 31) GO TO 7235
    TP(N,2) = (TP(N,2) - 32.) * TP(204,2)
7235 IF (TP(N,2) .GT. -3.0 .AND. 35.0 .GT. TP(N,2)) GO TO 7250
C
C   THE TEMPERATURE EXCEEDS NEPTUNIAN BOUNDS.
C
    PRINT 7237, N
7237 FORMAT(10X,31HTEMPERATURE PROFILE CARD NUMBER,I4,19H EXCEEDS ITS B
10UNDS.)
C
C   CHECK IF SALINITY IS WITHIN NEPTUNIAN BOUNDS.
C
7250 IF (SAL .GT. 0.0) GO TO 7254
    K = N
    IF (K .GT. 1 ) GO TO 7260
    IF (TP(210,3) .GE. 0.0 .AND. 43.0 .GT. TP(210,3)) GO TO 7260
    GO TO 7256
7254 IF (TP(N,3) .GE. 0.0 .AND. 43.0 .GT. TP(210,3)) GO TO 7260
C
C   THE SALINITY EXCEEDS NEPTUNIAN BOUNDS.
C
7255 PRINT 7257
    PRINT 7237, N
    GO TO 7260

```


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```

      TARGET(L,J) = TARGET(N+1,J)
8250  I = I + 1
      IF( I.LE.N ) GO TO 8220
      L = L + 1
      IF( L.LT.N ) GO TO 8210
      TARGET(1010,J) = N
8260  CONTINUE
      CALL BTPL0T(TP)
C
C      SET THE MAXIMUM REVERSAL INCREMENT.
      IF( REVMAX(2).GT.REVMAX(1) ) GO TO 8270
      REVMAX(3) = 0.0
      GO TO 8300
8270  N = TARGET(1010,1)
      REVMAX(3) = (TARGET(N,1)-TARGET(1,1))/(REVMAX(2)-REVMAX(1))
C
C      SORT THE SONAR ANGLES.
8300  N = ANGLES(1010)
      IF( N.LT.1 ) GO TO 8400
      DO 8305 L=1,N
      IF( ABS(ANGLES(L)).GT.1.0E-4 ) GO TO 8305
      ANGLES(L) = 0.0
8305  CONTINUE
      IF( N.LT.2 ) GO TO 8400
      L = 1
8310  I = L + 1
8320  IF( ANGLES(L)-ANGLES(I) ) 8350,8330,8340
8330  ANGLES(I) = ANGLES(N)
      N = N - 1
      GO TO 8350
8340  ANGLES(N+1) = ANGLES(I)
      ANGLES(I) = ANGLES(L)
      ANGLES(L) = ANGLES(N+1)
8350  I = I + 1
      IF( I.LE.N ) GO TO 8320
      L = L + 1
      IF( L.LT.N ) GO TO 8310
      ANGLES(1010) = N
8400  RETURN
C
C
C
C      TERMINATE CONGRATS.
      -----
9000  PRINT 9002
9002  FORMAT( 1H1, 9X 28HCONGRATS HAS BEEN COMPLETED. , /, 1H1 )
9030  IF( NTAPE2.EQ.0 ) GO TO 9090
      END FILE 2
9090  STOP 5
C
C
C
C      READ MISCELLANEOUS DATA.
      -----
C
C      READ THE FREQUENCY.
9100  TARGET(1008,3) = TEST(7)
      IF( (IUNITS-27)*(IUNITS-28) ) 380,9110,380

```

```
9110 TARGET(1008,1) = ATTN(TARGET(1008,3))  
PRINT 9112, TARGET(1008,1)  
9112 FORMAT( 24X, 12HATTENUATION , 12X 6HDB/KYD, 6X F12.5 )  
LINES = LINES + 1  
GO TO 100  
  
C  
C READ THE MAXIMUM NUMBER OF REVERSALS.  
9200 REVMAX(1) = TEST(7)  
REVMAX(2) = MAX(TEST(7),TEST(8))  
REVMAX(4) = TEST(9)  
TEST(8) = REVMAX(2)  
IONITS = 15  
IF( REVMAX(2).LT.201.0 ) GO TO 320  
PRINT 9202  
9202 FORMAT( 10X45HTHE MAXIMUM NUMBER OF REVERSALS EXCEEDS 200.0 )  
GO TO 140  
END
```